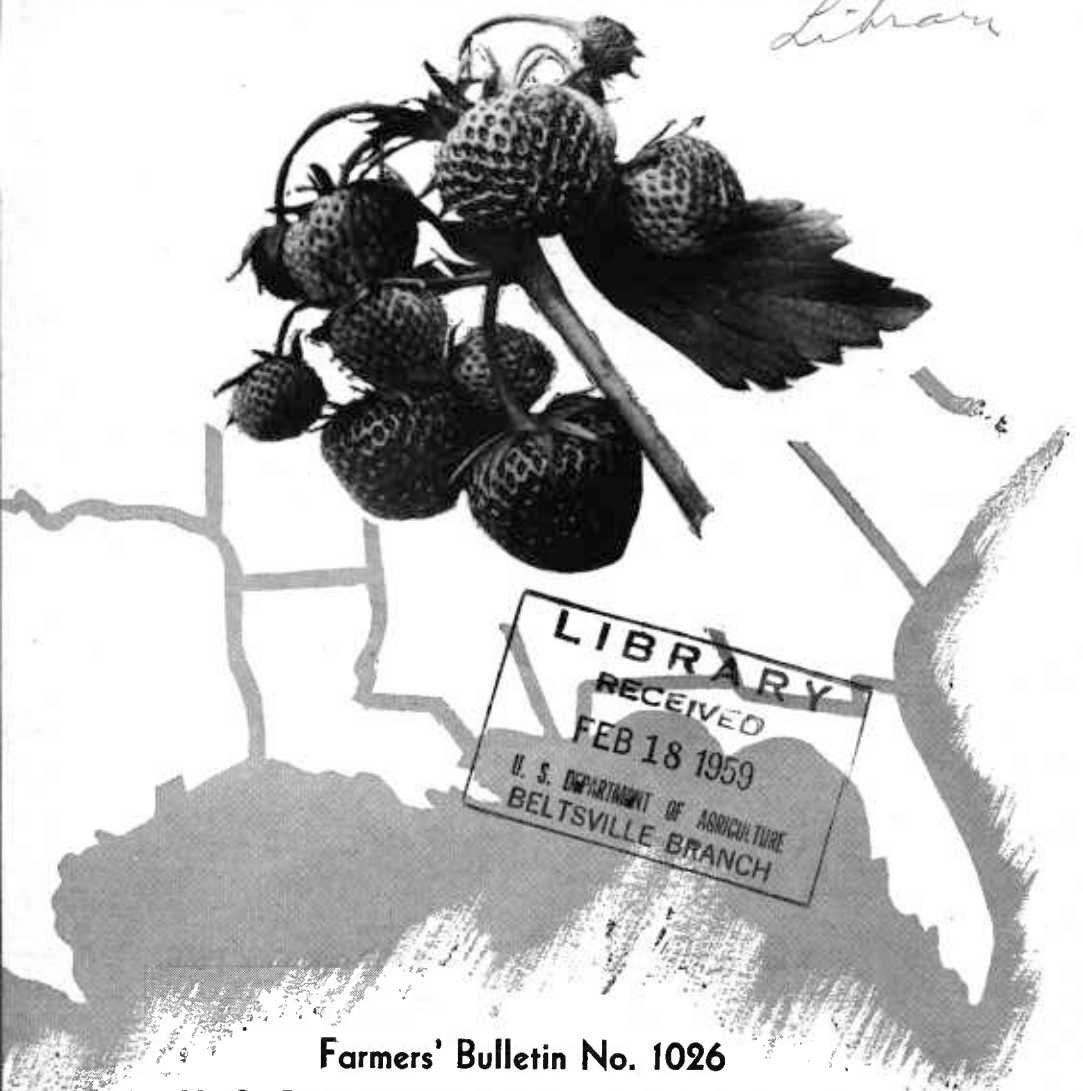
STRAWBERRY CULTURE

SOUTH ATLANTIC and GULF COAST REGIONS



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STRAWBERRY CULTURE

SOUTH ATLANTIC and GULF COAST REGIONS

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Strawberry growing is an important industry in certain regions of the South Atlantic and Gulf Coast States. Because of the mild climate the plants grow almost all year. Flower buds usually are formed in the fall, winter, and spring. Farther north, they are formed only in the fall. The regions to which this bulletin applies are shown in figure 1.

Strawberry-growing practices in parts of the South are very different from those followed in other parts of the country, and for this reason directions for strawberry growing in other parts of the country are of little value.

The commercial importance of one strawberry-growing region compared with other regions is determined largely by the ripening period of the crop. Fruit from the South Atlantic and gulf coast regions is usually marketed when there is little or no competition. Strawberries are shipped to northern markets from the different areas throughout the winter and early spring. The shipments total about 11 percent of the entire crop of the United States. In recent years there has been increased shipping by truck, which has replaced rail shipments.

[1] Retired March 31, 1957.

Figure 2 shows the large centers of strawberry production in the United States and the approximate shipping season in each.

Location

Factors that determine a favorable strawberry-growing location are: Shipping facilities, available pickers, convenient source of supplies (such as crates and boxes), and the ripening time of the fruit. An area where the berries ripen at a time when markets are not well supplied, other things being equal, is better than one where there is competition from other areas. It is usually easier to get transportation, supplies, and experienced help where strawberry growing is a well-established industry.

Figure 2 shows that the strawberry-ripening season moves northward during the winter and spring. Shipping from each area ends when berries in the next area are ripe, but a poor crop in one area may provide growers south of that area with a longer shipping season than usual. The market for berries from any area can be determined by noting the time when berries ripen.

Shipping seasons along the Atlantic coast succeed each other about as follows: The Plant City

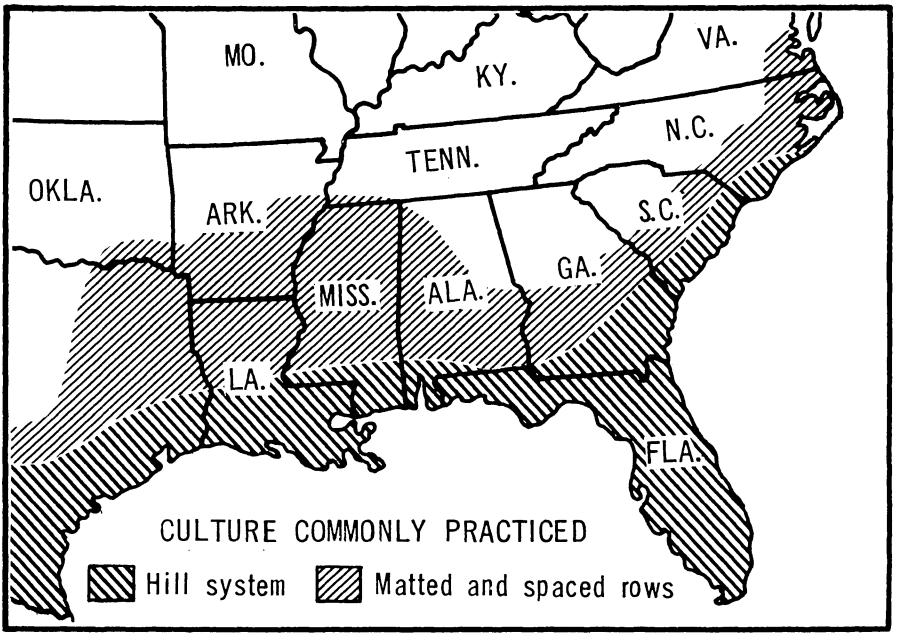

Figure 1.—The regions to which this bulletin applies are indicated by shading.

district in Florida is normally the only source of strawberries for northern markets in December and January. Shipments from that district usually are at their height in February when the Starke-Lawtey district in north-central Florida begins to ship small quantities. In March shipments from the latter district become heavy and those from the Plant City district become lighter, unless late frosts or other weather conditions retard ripening in northern localities and favor those farther south.

In the latter part of April shipments from North Carolina become heavy and those from northern Florida are discontinued. Shipments of berries from the Norfolk area replace those from North Carolina and are in turn succeeded by shipments from areas still farther north. There are similar successions of strawberry shipments in Louisiana, Alabama, Mississippi, Texas, and other States up the Mississippi Valley.

Soil

No particular type of soil is best adapted to the varieties of strawberries grown in a given area. In Texas, coarse sandy, fine sandy, and heavy gumbo soils are used extensively; in Louisiana, a heavy silt loam and sandy loam; in Florida, both heavy silt and coarse sandy loams and muck soils; and elsewhere, still other soil types. In each section the soil type most easily managed and having the greatest content of humus (decaying vegetable matter) is generally preferred. In the section about Hammond, La., a silt loam mixed with sand is favored; and in the Plant City district in Florida, a black sandy soil.

Drainage

The strawberry is easily injured by poor soil drainage and requires soils on which water never stands.

In the regions to which this bulletin applies, this is especially important, because the land is usually low and often poorly drained. In winter the evaporation is less than at other seasons, and when heavy rains occur, the plants may be drowned out or so weakened that their growth is stunted. Leaf, root, and fruit diseases are also more abundant on such sites than where the drainage is good.

Preparation

Land should be thoroughly prepared for growing strawberries. It should contain abundant supplies of humus when the plants are set. The humus may be supplied either by applying adequate quantities of manure or by growing and turning under one or more green-manure crops before the plants are set. Legumes, such as crotalaria, clover, soybeans, cowpeas, or some other crop adapted to the region, are preferred.

In most of the South Atlantic and gulf coast regions, the land is low and drainage is often poor. For this reason the strawberry plants are commonly set on ridges 3 to 12 inches above the furrows that separate them (fig. 3). Plowing methods that will form suitable ridges and furnish good drainage should be used.

The height and width of the ridges will depend on the character of the soil and on the slope of the field. Ridges 6 to 9 inches above the bottom of the furrows are usually adequate. The width of the ridges varies greatly in the different areas. The tops of the ridges are usually leveled with a plank drag before planting. Further information may be found under "Planting and Training Systems," page 14.

Soil Insect Control

Formerly it was essential to begin preparing the soil 2 years before planting strawberries because of insect injury that usually followed the planting. Now the use of 10

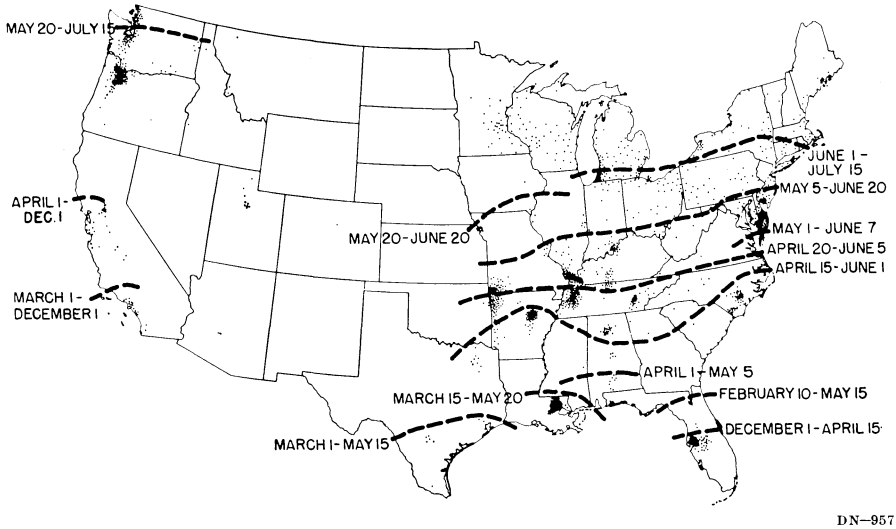

Figure 2.—Dates and broken lines show the approximate shipping season in the major strawberry-producing areas, and the northward progression of the ripening season. Dots show the location of large centers of strawberry production.

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Figure 3.—This field has been plowed into ridges for better drainage and has been set to single rows on the raised beds. (Photographed at Independence, La., January 28.)

pounds of actual chlordane per acre, once in 5 years, controls white grubs and many other soil insects. Sod land or land used for many other crops can be plowed, harrowed, and planted at once.

Nematode Control [2]

Strawberries are liable to damage by several kinds of nematodes, and this fact must be considered in selecting a site and preparing the soil. There are at least 3 harmful root nematodes and 1 harmful bud nematode in the South Atlantic and gulf coast regions.

[2] For additional information, see USDA Leaflet 414, Reducing Virus and Nematode Damage to Strawberry Plants.

ROOT NEMATODES. — The nematodes that cause root damage are 1/60 to 1/20 inch in length. They penetrate and feed in the small roots of plants and kill off much of the root system. The plants attacked by root nematodes show weak growth and have yellowish foliage.

The root-knot nematodes cause numerous swellings or knotlike enlargements, which interfere with the passage of water through the roots (fig. 4). Roots can be seriously affected by root-knot nematodes, however, even when no prominent enlargements can be seen. These gall nematodes may be found wherever strawberries are grown and are very common in the South Atlantic and Gulf Coast States.

In nearly all parts of the South there are generally meadow nematodes in the soils. In Florida a harmful sting nematode has been found. These nematodes, which damage the roots of strawberries by stunting their growth, also attack a great many other crop plants and weeds, and remain in the soil after the crop has been harvested and the soil plowed. It is often difficult to find land that is free of these pests.

Since nematodes feed only on living plant roots, most of them can be starved out by fallowing the land. To make this method effective, the farmer must keep the land free of vegetation, including weeds, for

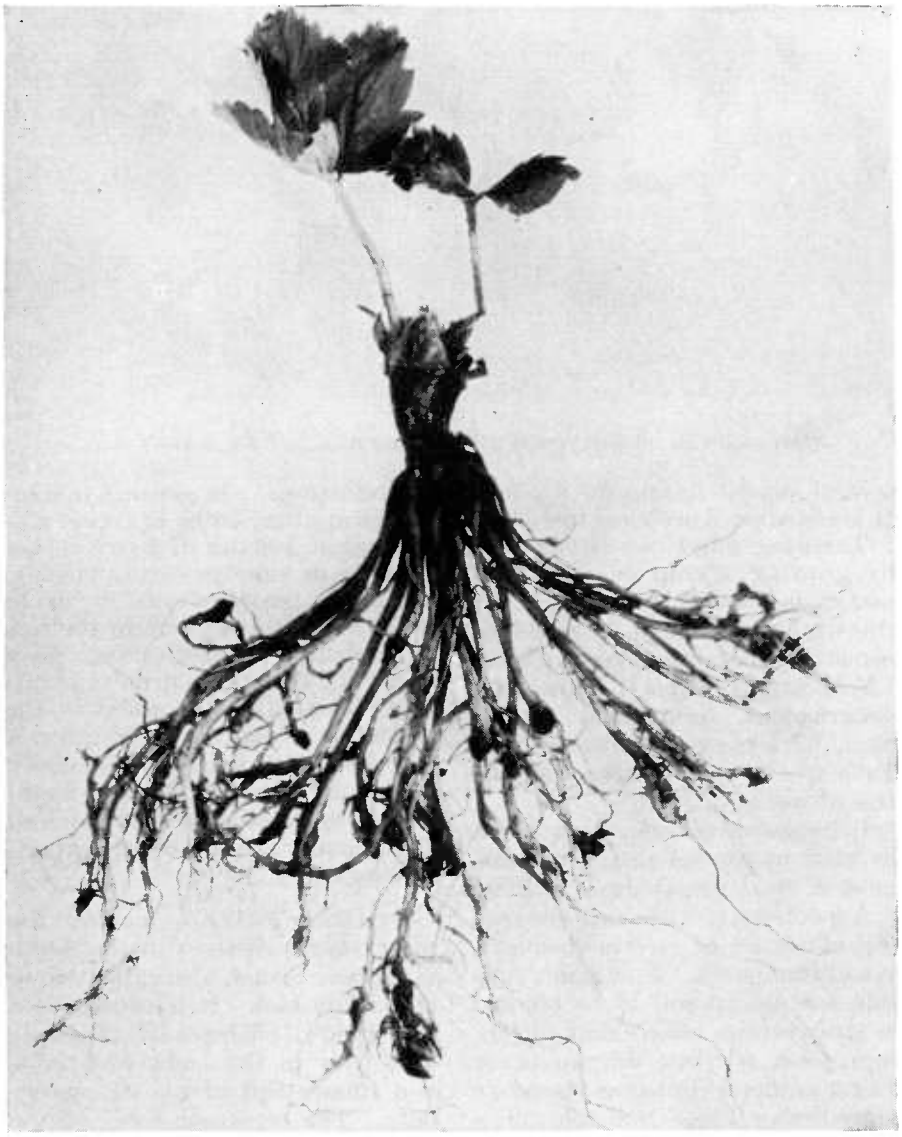

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Figure 4.—Roots of a strawberry plant showing galls caused by root-knot nematodes.

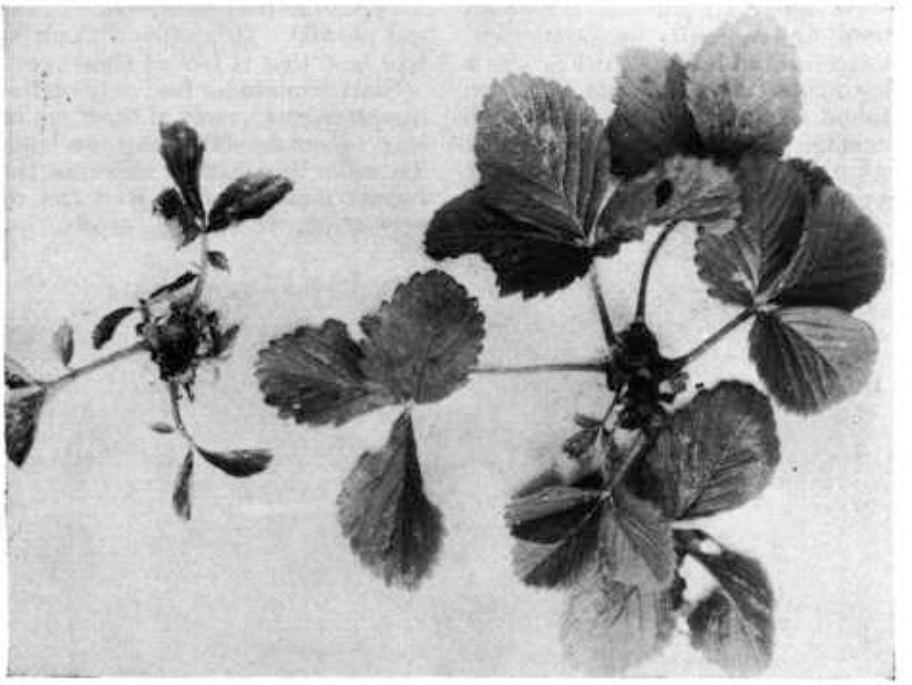

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Figure 5.—Left, plant affected with summer dwarf; right, healthy plant.

several months during the summer. It is not always practical to do this.

The same effect can be obtained by growing a crop on which the nematodes cannot feed. In using this method to combat the root-knot nematode that attacks strawberry (*Meloidogyne hapla*), plant oats, watermelons, crotalaria, cotton, okra, barley, rye, wheat, or corn. Take special care to keep the crop free of weeds.

Information on crops that might be used to control meadow nematodes or sting nematodes is lacking.

A quick method of nematode control is the use of certain chemicals as soil fumigants. Fumigants suitable for use on soil to be planted to strawberries have either dichloropropene, ethylene dibromide, or dibromochloropropane as the active ingredient. These are sold in a variety of formulations and should be applied as recommended by the manufacturer. In general, this involves application by injection into the soil at a depth of 6 to 8 inches 2 weeks or more prior to planting.

Florida growers use 10 to 15 gallons of DD per acre in the row to be planted to strawberries. They apply it 2 to 3 weeks prior to planting. This kills nematodes in the soil strip where the roots grow.

Information on the value of soil fumigants and on rates and methods of application can be obtained from county agents or State experiment stations.

SUMMER DWARF.—One of the most serious diseases in the South is summer dwarf, also called crimp and white bud. It is caused by a nematode (*Aphelenchoides besseyi*) that lives in the buds, leaf axils, and runner tips of the strawberry only. The nematode feeds on the buds and young tissues, killing or distorting them.

Often no blossoms or berries and few or no runners are produced. Affected plants have a peculiar twisting and dwarfing of the central and younger leaves (fig. 5), and the diseased leaves have a gloss and a green color that is darker than normal. These symptoms appear from July to October. Except in Florida, they disappear during the winter and reappear the next July.

All affected plants and connected runner plants in propagating beds and nursery fields should be discarded. The nematode is often washed out of affected plants by rains and irrigation water and can be carried downgrade to other plants. It is best to avoid planting on infested lands for at least a year.

Growth of the plant

Healthy strawberry plants, set in a moist soil, produce new fine fibrous roots within a few days. For this reason they may be set in winter, spring, summer, or fall.

If normally cool weather prevails in late fall or winter, they may be set with all the leaves on, and will grow better than do those with the leaves taken off. In the spring and summer all the leaves should be taken off, or a great amount of care should be taken by such means as shading or spraying to reduce water loss from the leaves. New leaves appear almost as soon as the roots. If the new root system is extensive, the new leaves are large, and there are several of them.

If the plants are set from about March 1 to April 1, runners appear from buds in the leaf axils in 30 to 75 days, and they continue to be produced until October or a little later. When the days shorten to about 12 hours in the fall, the growing points in the crowns of the oldest and largest plants start changing into flower buds.

In the Northern States the change into flower buds occurs mostly in September and relatively fast. In the regions to which this bulletin applies, flower-bud formation occurs later, is spread over a longer period, and is affected far more by environmental conditions.

Daylight periods of 12 hours or less and cool temperatures are most important in flower-bud formation. Each variety has a different day-length, cool-temperature requirement. Missionary is adapted to the warmest temperatures, Klondike to slightly cooler temperatures, and Blakemore to still cooler temperatures. Of these three, Missionary makes flower buds under the longest day-length. Klondike has a shorter and Southland a still shorter day-length requirement.

The change into flower buds occurs in the oldest and strongest plants first and in the youngest and smallest plants last.

In any plant the growing point of the terminal crown changes to a flower bud first, followed by the growing points of lateral crowns. If the plants are growing vigorously, the change may possibly occur slightly later, but the resulting flower buds and the individual flowers and berries are larger. New crowns that form flower buds develop as long as growing conditions remain favorable.

Records of many plants with different numbers of leaves have consistently shown that the greater the number of leaves on a plant, late in the fall, the greater the number of berries it will produce. At Willard, N. C., 4-leafed Blakemore plants averaged 22 flowers each, 8-leafed plants 44 flowers, and 9- to 11-leafed plants 52 flowers. In Maryland experiments with a different variety, plants with 4 leaves averaged 42 berries, those with 11 leaves 102 berries, and those with 42 leaves 230 berries. Figure 6 shows

the size of plants with 6, 10, and more than 40 leaves. Every practice, therefore, should be directed toward obtaining the largest possible individual plants in the fall.

In Florida flower clusters appear shortly after the flower buds form, since there is practically no rest period. Farther north the plants become partially dormant and the flower clusters do not appear until February or March. If a period of cool weather is followed by warm weather in midwinter, the flower clusters that develop may be killed. However, the warm-weather conditions that push out flower clusters also enable the plants to develop more flower buds to replace those that are killed (fig. 7). The first flower to open on a cluster is the largest flower and contains the most pistils. The fruit the develops from it is the largest and has the largest number of seed. The next flower develops into the second largest fruit, and later flowers develop into successively smaller berries.

The flowers are pollinated chiefly by bees. With moderate weather the berries mature in about 30 days after bloom. They mature slower with cool weather and more quickly with warm weather. When flower clusters are borne on a tall stem, the plant is not so likely to produce more clusters, but runners are produced. In central Florida the flowering season may be from December 1 to March 1, or even later in years with cool winters. In the North the flowering season is only 2 to 3 weeks long.

Obtaining plants

In Florida, because of nematodes and the need of the plants for a cold rest period to produce runners, growers usually obtain a limited number of plants each year from northern nurseries. These plants are set during the winter, about 3 feet apart in rows about 4 feet apart, and serve as mother plants for further propagation.

Parent Plants From the North

The following is the approximate schedule used in Florida:

January to March.—New "mother plants" from northern sources are obtained and set. These should start into growth at once.

June and July.—By this time the mother plants set from January to March should have developed enough runner plants to set a considerable area.

August.—The runner plants from the June setting should be ready for planting a more extended area.

September and October.—In turn, the plants set in June and July should have developed runner plants. Missionary plants should be set during the last week in September and Florida Ninety plants, October 8 to 15.

The exact time of making the original planting and the transplanting of the runner plants varies with weather conditions. The months given, however, are those in which the transplanting usually is done if moisture conditions are favorable or are under control (as when an overhead sprinkling system of irrigation is used). A field set in February to be used as a propagating bed is shown in figure 8.

Some growers prefer to leave the bed, made by runners from the original plants, until September and then attempt to encourage the development of vigorous runner plants. They set these runner plants in the plantation to bear fruit. This practice, however, has not been found so satisfactory as the one previously described, because the number of plants that must be brought from the North for the original planting from January to March is larger than the number of plants necessary when the transplanting is done in June. About 1,000 plants are set in February for each acre to be planted in the fall.

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Figure 6.—Plants with 6 leaves (*A*), 10 leaves (*B*), and more than 40 leaves (*C*).

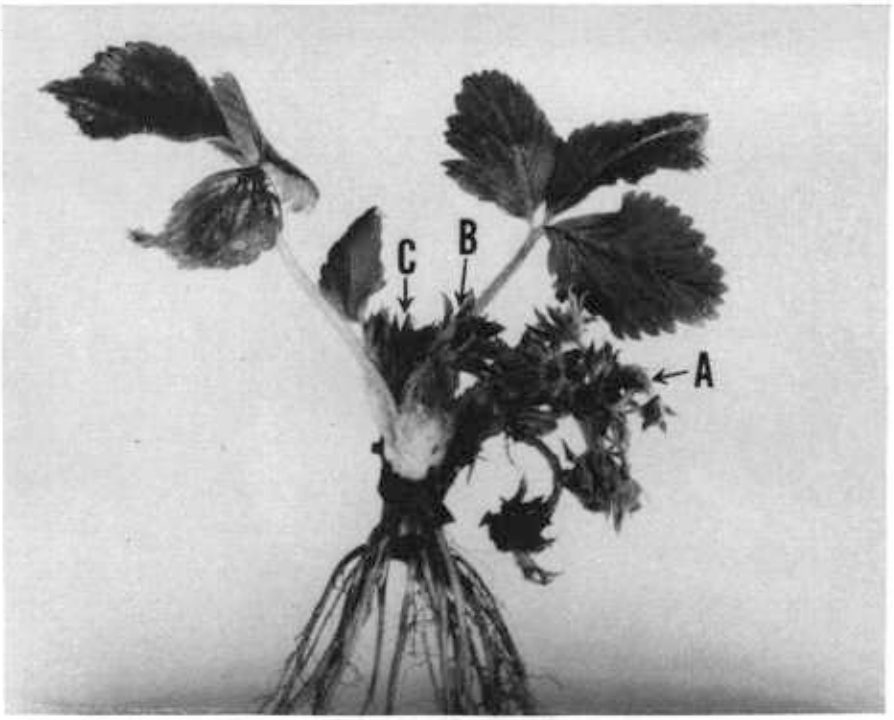

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Figure 7.—A plant of the Missionary variety with the first cluster of 11 flowers and buds (*A*) all killed by severe cold, but with a second cluster of 9 buds (*B*) and a third, very small cluster (*C*) not killed. Weather conditions that induced winter flowering also enabled the plant to develop more flower buds to replace those that were killed.

By following the practice first discussed it is possible to obtain enough plants to set a large fruiting area from a small original stock of plants. Moreover, plants raised in Florida in this manner will have larger crowns. They will bear much better than those brought from the North in October or November and set at once to fruit the following winter. In general, growers have found that it is unprofitable to set northern-grown plants in the fall for fruit production.

Raising Fruiting Plants

In the Louisiana strawberry area the plants are propagated from local stock. A part of the old field, which has fruited, is kept free from weeds. The runner plants from this bed are set in the autumn. Figure 9 shows a field at Hammond, La., that is to be used as a propagating bed. The mulch has been raked up and the weeds and poorer plants dug out. By November a wide bed of plants should have formed. Some of the most progressive growers transplant the runner plants in July, and from this new bed raise plants that are set later to make the fruiting plantation.

Because nematodes are common in Louisiana, the plants should come from fields as free as possible from these pests.

In some parts of southern Texas plants for the fruiting plantation are obtained each year from northern nurseries. Growers who follow

this course believe that they obtain better results than by using their home-propagated plants. In other localities plants are either propagated year after year from those locally grown or a stock is brought every few years from the North. Unless their home-grown plants are free from nematodes, growers in these localities should be able to increase their yields by obtaining their stock from the North each year. The northern stock should be healthy and should be grown in soil free from nematodes. Florida growers have found it necessary to obtain plants from as far north as Maryland, Tennessee, and Arkansas.

The following are suggested practices for obtaining plants for districts other than Florida:

Eastern North Carolina, Alabama, Mississippi (except Bay St. Louis), and Tyler, Tex., districts.—Obtain plants in February and March from the North or from local fields known to be free from nematodes. Use them to set permanent fields.

Hammond, La., and Bay St. Louis, Miss., districts.—Follow either of the methods specified below:

(1) *January to March:* Set mother plants from the North. *June 15 to July 15:* Use the best of the runner plants produced by those set from January to March to set a larger area of stock plants. *October to December:* Use the best of the runner plants produced by those set in June or July to set the fruiting plantation.

(2) *May:* Cultivate and weed out the bearing field or a part of it immediately after the picking season. *June 15*

16453

Figure 8.—These strawberry plants were brought from the North and set in February. By the first of June they will have made a dense mat of plants that will be used to set out a larger propagating bed. The plants grown on this plot will be set on a still larger area in August, and these will produce the plants that will be set in the fruiting beds in October. (Photographed at Plant City, Fla., March 27.)

18339

Figure 9.—Mulch has been raked from strawberry plants and is being stacked for use another season. The old plants have been cut out. The plants to be set in the autumn will be propagated from those remaining.

to July 15: Use the best of the runner plants from this cleaned area to set a new plantation for making plants. *October to December:* Use the best of the runner plants from the field set in June or July to set the fruiting plantation.

Houston, Tex., district.—December to March: Obtain plants from the North in sufficient quantity and set the permanent fruiting plantation.

In general, the planting seasons have already been indicated. Where the hill system (to be described later) is used, however, certain facts should be remembered.

In the Hammond, La., area, plants set in November are usually better than plants set at other times, though plants set as late as December 20 may be satisfactory.

Planting and training systems

Three systems of growing strawberries are generally used in the South—the hill, the matted-row, and the spaced-row systems. The map shown as figure 1 indicates the sections in which each system is principally used.

Hill System

Under the hill system the plants are commonly set in late summer or in the autumn, and the crop is harvested during the winter or the following spring. Usually plants set at that time make no runners, but if any do appear they are removed. When this system is used, the plants

may be set in single, double, or triple rows, as shown in figures 10, 11, and 12.

The double row is generally used in the central Florida area, but the single row is used in the Hammond, La., district, and in the Chadbourn, N. C., district. The plants are usually set about 1 foot apart in rows 3 feet apart, as shown in figure 10. Occasionally the rows are set 40 to 42 inches apart.

In the Starke, Fla., area, and to some extent in other areas, the double-row system is preferred. Where double rows are set in central Florida and in Louisiana, the rows are about 16 inches apart and the alleys 3 feet wide. The wider beds, on which two rows are set, allow more plants to the acre than when single rows are used.

Triple rows are used in the Starke, Fla., area and to some extent in Louisiana. If the drainage is good, three-row beds may be used. One very successful grower in Louisiana sets his plants in triple rows and spaces them 12 to 14 inches apart each way. His plan is illustrated in figure 12.

Matted-Row System

Under the matted-row system the plants are usually set in the winter or early spring, 18 to 40 inches apart, in rows 3½ to 6 feet apart, and the runners are allowed to root. The interval at which the plants should be set in the row depends on the probable danger of losing plants through drought or insects. If there is little danger, the plants may be set 40 inches or more apart, and runner plants may be trained to form a solid mat in the spaces between plants. Where loss is likely, the plants should be set about 18 inches apart.

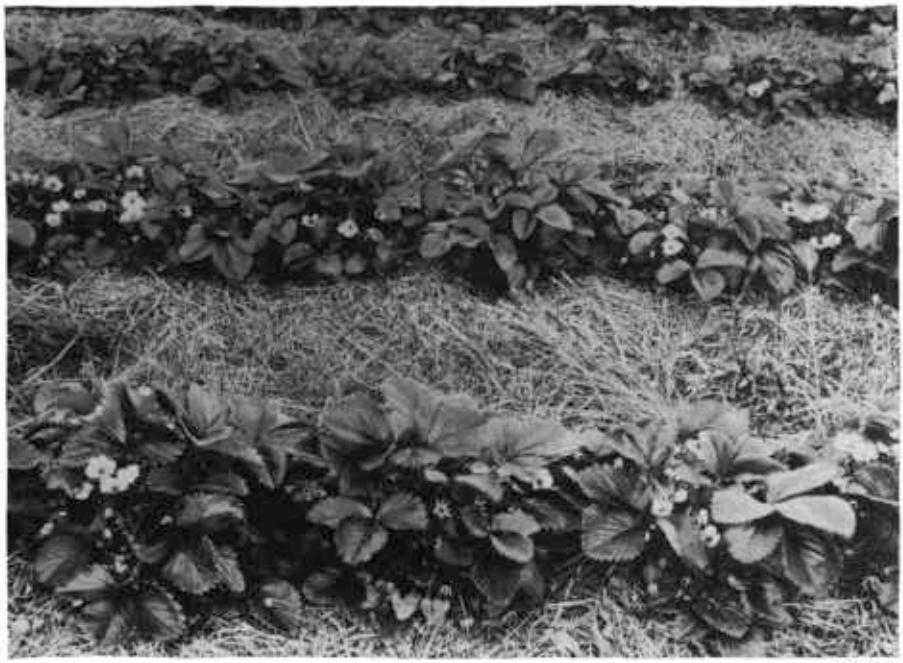

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Figure 10.—Strawberry plants trained to the hill system. The plants were set 1 foot apart in single rows, 2½ to 3 feet apart. All runners were kept off. (Photographed at Plant City, Fla., February 3.)

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Figure 11.—Strawberry plants set in two rows on each raised bed. The plants are 14 inches apart in the rows, which are 22 inches apart. The alleys between the beds are 32 inches wide. (Photographed at Starke, Fla., February 6.)

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Figure 12.—Strawberry plants set in three rows on each raised bed. This plan is followed in the Starke, Fla., area and to some extent in Louisiana. (Photographed at Hammond, La., November 22.)

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Figure 13.—Strawberries in narrow, matted rows. They are well grown and are mulched with straw. Under this system plants are commonly set in winter or early spring 18 to 40 inches apart in rows 3½ feet apart. The runners are allowed to root to make a narrow row.

The matted-row system is commonly used in the Wallace and Chadbourn, N. C., areas, in Alabama, in all the Mississippi area except Bay St. Louis, and in the Houston and Tyler, Tex., areas. Figure 13 shows a field grown under the matted-row system.

Spaced-Row System

In a spaced row the runner plants are placed or set by hand until the desired stand is obtained. Then later-formed runners are removed as they appear, or the surplus runners may be removed at one time or several times. The plants left to fruit should be spaced at a fairly uniform distance. In the final stand the plants are 6 to 12 inches apart and the rows 24 to 30 inches wide.

A modification of the matted row, sometimes called a spaced row, is formed by allowing all the runners to root. When enough plants are well rooted, the rows are raked across with a steel-toothed horse rake or a spike-tooth harrow, which has the teeth slanting back. Finally, a cultivator, with a circular disk next to the row, is run down the rows to cut off surplus runners. A thin stand of plants in an unspaced matted row is about the equivalent of such a thin matted row.

Comparison of Systems

In a comparison of training systems at Willard, N. C., the Blakemore variety was used. By November 1 the matted row had set a dense stand of plants with more

TABLE 1.—*Yield in quarts per acre, percentage of U. S. No. 1 and culls, relative size, percentage of decay after 1 day, average number of leaves formed per plant by Nov. 1, number of leaves per foot of row on Nov 1, and number of plants per foot of row of Blakemore strawberries under five systems of growing at Willard, N. C.*

Growing system	Yield per acre			Relative size	Decay after 1 day	Average leaves per plant Nov. 1	Leaves per foot of row Nov. 1	Plants per foot of row
	Total	U. S. No. 1	Culls					
	Quarts	*Percent*	*Percent*	*Percent*	*Percent*	*Number*	*Number*	*Number*
9-inch spacing, 24-inch-wide row	4, 993	84	16	88	8	9. 2	45	1. 8
6-inch spacing, 24-inch-wide row	4, 760	80	20	80	10	7. 0	70	4. 0
Double-hill row	3, 506	90	10	100	5	10. 0	10	. 7
30-inch matted row	2, 331	57	43	62	26	3. 0	220	30. 0
12-inch matted row	2, 098	68	32	72	16	------	120	------

than 30 plants per square foot. The plants were crowded and had few leaves per plant; the leaves were small; and many plants produced no berries the next year. The spaced plants in the 24-inch-wide rows and in the double-hill row were large and produced a good crop the following year, as shown in table 1. The greatest yield was in the 9-inch spaced row. The largest berries were produced in the double-hill row (fig. 14), and 1 day after picking they showed the least decay.

In this test, with a drought toward the end of the season, the percentage of marketable berries went as low as 18 percent for the 30-inch matted row; it was 90 percent for the double-hill row. Similar results have been obtained in other regions.

The cost of growing an acre in spaced rows is higher than in matted rows.

Number of Plants Needed To Set an Acre

Table 2 shows the number of strawberry plants needed to set an acre when spaced according to the systems commonly used.

Where there is little danger of plant loss, only the number specified will be needed. If there is considerable danger of loss, a somewhat larger number should be used in order to insure a full stand. The expense of caring for a field that has many blank spaces is out of proportion to the value of the crop.

TABLE 2.—*Number of strawberry plants needed to set an acre when spaced at different distances.*

Spacing		Plants to the acre
In the row	Between rows	
Feet	*Feet*	
1 by 1⅓ in double rows.	3	20, 260
1½	2	14, 520
1	3	14, 520
1	3½	12, 446
1½	2½	11, 616
2	3	7, 260
3	3	4, 840
3	4	3, 630

Care of plants before setting

Good plants, as they are received from the nursery, in bundles of about 25 each, are shown in figure 15. They should be kept cool and moist until set. If they are to be set the day they are received or the following day, they should be placed in the shade and covered with wet burlap. If, however, they cannot be set for several days, the bundles should be opened and the plants separated and heeled in, as shown in figure 16, or the entire shipment should be placed in cold storage at 32° to 40° F.

The plants should not be dropped far ahead of the setters, especially on dry, windy days. The workers dropping the plants should use some means of protecting their supply from drying.

Setting the plants

Set the plants by hand, with one of several hand tools, or with a machine. A planting machine is cheapest and best for planting large areas. Regardless of the method used, two things are of special importance—the right depth for setting plants and soil well firmed about the roots.

The proper depth for planting is illustrated in figure 17. Set the plants so that the crowns are even with the surface of the ground after

Figure 14.—A single picking from three rows of Blakemore strawberries to show the difference in grades and quantities produced under different systems of management. The boxes are arranged horizontally by grades: Front row, culls; second row, U. S. No. 1; third row, large; fourth row, fancy. ● *A*, Three boxes containing 2 quarts of berries from a 30-inch-wide matted row (no fancy and but few large berries). ● *B*, Six boxes containing 4 quarts from a row in which the plants were 9 inches apart (more than 2 quarts of large and fancy berries). ● *C*, Six boxes containing 4 quarts from a double-hill row in which the plants formed early (nearly 1 quart of fancy and 1½ quarts of large berries).

18645

Figure 15.—Plants received from the nursery are in bundles of about 25 each.

the soil has been packed about the roots. If the soil is not properly firmed, air gets to the roots, and they are likely to dry out. The plants may produce a feeble growth or none. If the soil is thoroughly firmed, there will be little trouble getting the plants to live.

Some growers step on each plant, after it has been set, to make sure the soil has been properly firmed. When this is done, the instep should come over the crown of the plant in order to avoid injuring it.

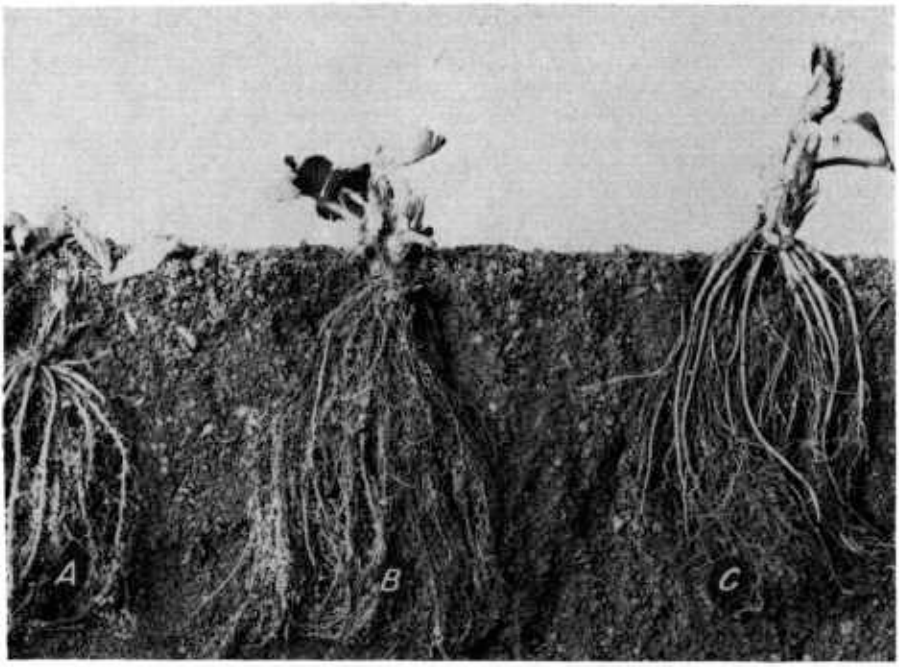
Setting With Hand Tools

Growers in most districts use a trowel or punch to make openings in the soil and to press the soil back around the plants. They make an opening about 6 inches deep, then insert the roots and press the soil back. When a punch is used, the workers follow each other. The first man makes the holes, the man behind drops the plants, and 1 or 2 others firm the soil around the plants. The punch cannot be used readily in soils having straw or stones in them, but is well adapted for use in loose soils. The trowel can be used in any well-prepared soil. Different types of trowels for this purpose are shown in figure 18.

Two men work together in setting plants with a spade. One man inserts the spade, forces it forward, and opens a hole. The second man carries the plants and inserts them in the holes as they are made with

18744, 18748

Figure 16.—Heeling in strawberry plants. Above: The bundles are opened and the plants are spread out in a trench, with the crowns even with the surface. ● Below: The trench shown in the top photograph has been filled with moist soil, and the soil is being packed firmly about the roots. The plants are left here until they are wanted for setting in the field.



21940

Figure 17.—Strawberry plants set at different depths: *A*, Plant is set too deep and will be smothered. ● *B*, Plant set at correct depth; note that crown is at the surface; it is important that the roots be straight down, as shown. ● *C*, Plant is set too shallow and will dry out.

the spade. After the roots are inserted, the first man withdraws the spade and, with his foot, presses the soil firmly about the roots. Plants can be set rapidly by this method, which is widely used.

Setting With Machine

Planting machines, which are used in trucking areas to transplant tobacco, tomatoes, cabbage, sweetpotatoes, and other plants, are often used to set strawberry plants on smooth land. If the soil is not moist, water must be applied when the plants are set. One man prepares the plants for the machine, another drives the machine, and two others feed plants into the machine. Experienced men can set about 30,000 plants a day, or 3 to 5 acres.

Although it is difficult to set all the plants at the right depth with the roots straight down with a planting machine, the droppers become expert with practice and set the plants better than by hand. A roller, attached to the planter, firms the soil. When all conditions are favorable, the machine may be used successfully, and the cost of planting is comparatively low, especially in areas where the weather is cool and moist for some time after the plants are set.

Care of plants after setting

Removing Flower Stems

Flower stems usually appear on winter- or spring-set plants soon after they are set. Until the plants become well established after transplanting, fruit production is a severe drain on their vitality; hence the flower stems should be removed

as they appear. Experiments have shown that early-formed runner plants produce the most fruit the following year, and removal of flower stems helps in getting early runners.

Width of Matted Rows

In general, matted rows should not be more than 24 inches wide, and many growers find that 12 to 15 inches is better than a greater width. It is easier to harvest the berries from narrow rows, and most varieties of strawberries, especially the Blakemore, produce better in narrow rows. If the row is more than 2 feet wide, some ripe berries along the center are likely to be overlooked by the pickers. Unless the plants are well spaced many berries are likely to be small.

It will often be necessary to thin the plants in matted rows during the summer and autumn. Roller cutters are attached to the cultivator, and all runners extending into the alleys are cut off when the cultivating is done. Surplus runners may also be removed when the field is hoed.

Where the matted row is 2 feet wide, growers sometimes run a bull-tongue plow, with a point 4 or 5 inches wide, down the center of each row about the first of September in first-year beds or immediately after harvest in 2-year beds. This tears up the center plants and cuts the row into two parts that might be called a double-matted row.

Spacing Plants

Under the spaced-row system of culture, the runner plants are spaced by hand rather than allowed to root by chance. The exact distance and plan of spacing are determined by local conditions.

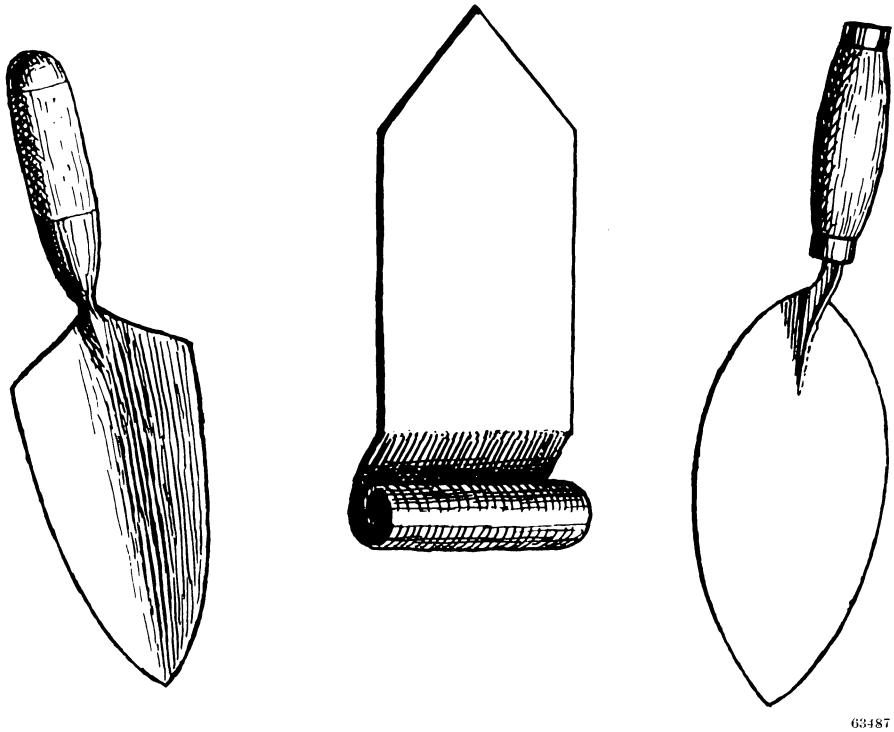


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Figure 18.—Different types of trowels commonly used in transplanting strawberries. The best for most conditions is shown in the center.

BN—4207

Figure 19.—A double-hill row completed before the end of July. The runner plants are rooted about 12 inches apart in the row to make double rows about 12 inches apart. Plants with 6 leaves by August 1 may have 20 or more leaves by the end of the growing season and produce at the rate of 400 or more bushels per acre.

As soon as the tips of the first runners begin to enlarge, they should be placed in the rows between the mother plants, or to the side and covered with soil, as shown in figure 19. The next plants should be placed 6 to 12 inches out from the original row and on each side of it. Additional runners may then be rooted until a wide row has been formed, with the plants at least 6 inches apart. Thereafter, all runners should be cut off as they develop.

Tillage

In the Florida areas it is necessary to keep down weeds and maintain the soil in good physical condition until the mulch is put on. This is usually sometime in December in the central Florida area, and in January or February in the Starke area. Before the mulch is applied, hoes and cultivators are generally used for tillage, but after the mulching is done, only hoes are used.

In the Louisiana district weeds should be kept down and the soil maintained in good tilth by hoeing and cultivating until cold weather sets in. Because certain weeds grow vigorously throughout the winter, much hoeing is necessary during that period. The weeds must be scraped from around the plants, as shown in figure 20. At this time or as soon as possible afterward, a cultivator should be run in the alleys. If weeds continue to grow, the alleys should be hoed or given a shallow cultivation. Care should be taken to keep the alleys open, so that water may drain off freely; also the strawberry roots should be disturbed as little as possible. In this district the mulch is usually applied during February. If weeds develop after this time they are kept down with a hoe. In both hoeing and cultivating, the soil is worked toward the plants, not away from them.

Growth of new leaves takes place at the top; so the crown grows out of the ground, though slowly. All new roots from the crown grow out at the base of the new leaves. Because the new roots are readily killed by dry air, it is important to hoe and cultivate the moist soil toward the plants to give the new roots a chance to form.

In areas outside of Florida and Louisiana, cultivation should begin immediately after planting. It

should be done each week or 10 days until late autumn or into the winter when the mulch is applied. Because tillage will keep down weeds, no hoeing is usually necessary in the spring.

Companion cropping

When strawberries are spring planted, vegetables are sometimes grown as companion crops to get returns from the land during the first summer. The vegetables are planted along the rows or in the alleys between the rows. This practice is followed especially where the matted-row system is used.

Many kinds of vegetables may be raised in this way, and the thorough cultivation given them will be sufficient for the strawberry plants. Most vegetables, however, are susceptible to root-knot nematodes, and care should be used to see that infested plants are not set in the strawberry plantation. Vegetable seeds do not commonly carry nematodes.

Onions may be grown in the strawberry rows, as shown in figure 21. Quick-maturing plants such as lettuce, radishes, peas, and carrots may be grown between the rows, as shown in figure 21. The extra fertilizer and careful culture given these companion crops are an advantage to the strawberry plants. The strawberry rows are planted the same distance apart as under ordinary conditions. The vegetables are removed before the strawberry plants begin to spread over the ground.

When crops such as beans, peas, and cabbage are grown with strawberries, special systems of planting the vegetables are often used. Cabbage or cauliflower may be set about 6 inches to one side of the strawberry row. The strawberry plants will be shaded to some extent by the leaves of the cabbage or

BN—4204

Figure 20.—A common practice in southern Louisiana is to hoe or scrape the weeds from the rows of plants into the middles. This is done late in January or in February, and pine-straw (needles) mulch is then applied.

16867, 16845

Figure 21.—Strawberries with vegetables as companion crops. Above: Onions as a companion crop in the rows. The onion sets are planted in the spring; they are removed early in the summer, and all the space is left for the strawberries. ● Below: Companion crops between the rows. At the left, lettuce, carrots, and beets alternate with the rows of strawberries; radishes have been harvested at the right; and beans are growing at the extreme right.

cauliflower, but when the vegetables are removed during the summer the strawberries will spread over and occupy the whole space.

When beans are used as a companion crop, the strawberry rows are usually set somewhat farther apart than in ordinary practice, and the beans are planted in the middle of the alleys between the rows. The strawberry rows should be spaced 4 or 4½ feet apart. Until the beans are harvested, only a narrow mat of strawberry plants should be allowed to form.

Potatoes or corn should not be used as companion or preceding crops. With the first, there is a danger of verticillium wilt, and with the second a danger of root aphids.

Strawberries as an intercrop

In many sections strawberries are grown as an intercrop in peach, apple, fig, orange, or other tree-fruit orchards. When the orchard is first planted, strawberries may be set out and grown for several years before the trees need all the ground. The strawberries furnish some income from the land or at least pay the expense of caring for the orchard. The intensive cultivation given strawberries is especially good for young orchards. Because strawberries do not bear well unless moisture conditions are good, they may prove a good indicator of these conditions.

Mulching

A mulch is used in most strawberry fields in the South. Its principal uses are to keep the berries clean, to prevent decay, to conserve moisture, to protect the flowers from frost, and to keep down weeds. The mulching materials most commonly used in the South are pine needles, wild hay, and wheat, rye, and oat straw; all are satisfactory. When pine needles are used, they are raked during the winter and are usually stacked along one side or on both sides of the field.

In nearly all parts of the South the mulch is applied just before the blossoms open. The mulch is distributed along the rows from a truck and placed around the plants by hand, as shown in figure 22.

After settling, the mulch should be 1 to 3 inches deep.

In the central Florida area the mulch is used to protect the flowers and fruit from frosts. The mulch is put in the alleys, and when there is danger of frosts it is spread over the plants. A small quantity of pine needles, wild hay, or straw, used as a mulch, will afford protection from ordinary frosts. The temperature above a mulch is several degrees lower than that above an unmulched field. Growers should, therefore, use caution in frost protection when mulch is used.

Where a mulch is used, some of the berries are likely to be lost through cricket injury at the beginning of the strawberry season. The crickets hide in the mulch by day and eat the ripening fruit at night. Unless partly eaten berries are picked, they may rot and spread disease to neighboring berries. The damage done by crickets is not often serious. It may be largely prevented by scattering a commercial bait along the rows.

Preventing frost injury

In nearly all parts of the South Atlantic and gulf coast regions, frost causes more loss than in most other strawberry-growing regions. Loss of an average of 6 or 7 flowers per plant is not unusual in spaced plantings. Normally, the first flowers to open develop into the largest

BN—4206

Figure 22.—In mulching, straw or wild hay is distributed along the rows from a truck, spread by fork, and placed around the plants by hand. See also figures 9, 10, 11, and 20.

berries, and 6 flowers per plant represent a loss of 4,000 to 5,000 quarts per acre of the best and earliest berries. Losses in matted-bed fields probably average less than in spaced plantings because yields in matted beds are smaller.

Frost injury is most commonly prevented by covering the plants with a mulch and by spray irrigation. A light covering of mulch will protect against most frosts, and hundreds of acres are covered. In cool weather the flowers can be pollinated over a period of several days, and the mulch may be left over the plants 2 or 3 days if frosts are expected on successive nights. V-shaped troughs, made of 1-inch by 10-inch and 1-inch by 12-inch cypress are sometimes placed on the north side of each row. They are inverted over the plants in case of frost, and have proved to be an effective protection in Florida fields. Coverings of muslin, cheesecloth, or kraft paper are sometimes used.

Spray irrigation is especially effective in preventing frost injury. Nozzles with small openings are used since it is unnecessary to use as much water as in ordinary irrigation. The spray should be started whenever the temperature drops to 32° F. and continued until all ice has melted and the temperature is above 32°. With an increase in irrigation of strawberries, this method of frost control is rapidly increasing. Large power-driven fans are sometimes used for frost protection on low areas. This method of protection is worth considering where conditions are favorable. Oil heaters are effective under some conditions.

Use of fertilizers

The principles that apply to the use of fertilizers on other crops apply generally to their use on strawberry fields. Because of differences in soils the use of fertilizers is chiefly a local problem that must be solved by each grower. The proper fertilizer application can be determined by applying the vari-

ous plant foods, such as nitrogen, phosphoric acid, and potash, to small plots. The plant foods should be applied separately and in different combinations and quantities. Stable manure can also be tested. A record of the yields from the plots should be kept.

The Coastal Plain soils of the South Atlantic States need large applications of fertilizer. Most gulf coast soils are well supplied with plant food, and good crops of strawberries are produced with much less fertilizer, provided the soil is kept in satisfactory physical condition by the addition of humus, by adequate drainage, and by frequent tillage.

In the Houston, Tex., area, ordinarily no fertilizer is used under any strawberry training system.

Investigations in North Carolina indicate that nitrogen is the most important element in fertilizers applied to strawberries. Nitrogen may be profitably applied from early September until December or January.

Because the availability of nitrogen in different fertilizers varies, the source of the nitrogen is important. Nitrogen from mineral sources such as sulfate of ammonia and nitrate of soda is quickly available, but nitrogen from organic sources, such as cottonseed meal, tankage, fishmeal, and Peruvian guano, is available more slowly.

A fertilizer containing 3 to 5 percent of nitrogen should be satisfactory, provided the nitrogen is partly from mineral sources and partly from organic sources. If inorganic or mineral nitrogen only is used, it will require several applications to give the best results, because mineral nitrogen dissolves quickly and may be leached out in a short time.

Sulfate of ammonia tends to make the soil more acid and should not be used if the soil is inclined to be too acid (pH 5.5 or lower). Insufficient nitrogen in the soil results in small crops, and the berries may mature much later. Too much nitrogen may make dense foliage and cause the berries to mature late. The dense foliage and shade may make the fruit more likely to rot.

In experiments in eastern North Carolina, applications of 60 pounds of nitrogen per acre, half derived from inorganic fertilizer (nitrate of soda and sulfate of ammonia) and half from organic sources (cottonseed meal and tankage), increased yields for 3 years an average of 95 percent (3,144 quarts). The addition of potash (75 pounds of K) and superphosphate (20 pounds of P), or both, with the nitrogen, caused a decrease of 1,163 quarts in the yields that had been obtained with nitrogen alone.

In the North Carolina investigations, during 2 years of hot, dry weather, plant foliage appeared to stand up much better with potash applications. Plants that received mineral nitrogen and no potash did not stand up so well. In one season, berries treated with phosphorus in addition to nitrogen were much better flavored than those treated with nitrogen only. Berries treated with potash had a poor flavor. There was no real evidence that potash or phosphorus tended to make the berries firmer or to increase the crop. In experiments in Arkansas and Texas, increased yields have been obtained by the use of phosphorus.

Until more is known about the fertilizer requirements of strawberries, a fertilizer with an analysis of about 3 to 5 percent of nitrogen, 6 percent of phosphorus, and 2 percent of potash can be used. Experiments made so far indicate that at least half of the nitrogen should come from organic sources.

The following recommendations suit average conditions in eastern

North Carolina (the amounts are for 1 acre):

1. In September and again in December or early in January, apply 750 pounds of a complete fertilizer.

OR—

2. In early fall, apply 750 pounds of a complete fertilizer. In late fall, apply a top dressing of (*a*) 250 pounds of nitrate of soda or (*b*) the equivalent in cottonseed meal, tankage, or other source of organic nitrogen.

Since potash and phosphorus, applied as a top dressing, move down into the soil only slightly, they do not become fully available to plants. When a mixed fertilizer is applied, it should be placed down beside the roots along the sides of the rows in a shallow furrow that has been turned away from the plants. Nitrogen readily goes down into the soil, and if nitrogen only is used, a top dressing is very satisfactory.

In Florida 400 to 600 pounds of a 4-4-8 or 4-8-8 fertilizer is thoroughly mixed with the soil in the row, 1 or 2 weeks before planting, or it is applied as a side dressing 10 days after setting. Another application with the same amount is made 6 to 12 weeks later. The fertilizer is placed between the double rows or along one side of a one-row bed. In Louisiana an application of 1,000 pounds of a 4–12–4 fertilizer is recommended.

Use of lime

In a strawberry field, lime may be useful in several ways. It is a source of calcium, and, in the form of dolomite, it is a source of magnesium. Lime also lessens the acidity of the soil.

Strawberries usually grow well on light soils where the acidity measures pH 5.5 to 6.5 They may grow well where the acidity measures pH 5.0 to 7.0 if there is a great deal of organic matter in the soil. On heavy soils the range of acidity for good growth is somewhat greater. Where the soil is pH 4.5 to 5.3, lime is needed, and an application of 1,000 pounds (light soils) to 2,000 pounds (heavy soils) should be made. Where the soil is pH 4.5 or less, 1,500 pounds (light soils) to 3,000 pounds (heavy soils) should be applied.

Lime ties up free aluminum, which is toxic to strawberry plants, and makes calcium and magnesium available. It may also help the tilth of the soil. Lime must be applied with care because an excess is harmful, dwarfing the plants and reducing the size of the berries. It is best to apply lime a year or two before the strawberries are planted and disk it into the soil.

Irrigation

It is generally necessary to irrigate strawberries because droughts occur often during the long growing season and a serious loss may result. About 80 percent of the growers in Florida and most of the growers in Louisiana have some type of irrigation system. Either the spray or the surface system is used, depending on local conditions. The spray system is most often used in Florida, and surface irrigation is used in Louisiana and Texas.

A portable-pipe spray system costs $75 to $450 per acre. The cost depends on the area to be irrigated at one time.

Water for surface irrigation is usually obtained from artesian wells in the Hammond, La., area and is pumped from bayous, streams, and lakes in the Houston, Tex., area. In Florida water is obtained from wells, lakes, and streams.

A flowing artesian well provides a continuous water supply. After the well is bored, the only cost is distributing the water. When drought occurs in summer, irrigation is used to save the propagating

BN—4209

Figure 23.—Irrigating strawberries during the picking season. Water is run down every other alley; alternate alleys are left dry for pickers. (Photographed at Ponchatoula, La., April 13.)

beds. Irrigation is frequently applied to moisten the soil for setting and most frequently to counteract drought during the fruiting season.

In surface irrigation, the alleys should be free from obstacles when the water is applied. The water runs down the alleys without much loss if the rows are not more than 500 feet long. During the planting and picking seasons water is run down every other alley. The workers can walk in the unirrigated furrows. The unirrigated alleys should be watered at the time of the next irrigation. If the soil is in suitable condition for working, the irrigated alleys should be cultivated about 2 days after each irrigation.

Irrigation is used somewhat less than formerly in the Houston, Tex., area, where there is considerable expense in installing and maintaining pumping stations, and where heavy rains may occur in any season. If an irrigation is followed by heavy rains, the plants may be damaged severely. Because severe droughts are common, it is necessary to irrigate in the summer. Irrigation is used at planting time, and it is used in the harvest season to keep the fruit as large as possible.

Renewing plantation

The plantation is seldom renewed under the hill system, but is plowed up at the end of the first fruiting season. Under the matted-row system, the cost of renewing is usually less than the cost of setting and caring for a new plantation. Where the matted-row system is used, the

fields are kept 2 to 6 years, or as long as they produce profitable crops. The length of time a plantation remains profitable depends on the quantity of humus in the soil and on the prevalence of diseases, insects, and weeds.

If green-manure crops are turned under before the plantation is set and the soil is in good condition, two or more crops may be harvested before the plantation is plowed up and a new one set. If a field becomes weedy, it may be more profitable to use the land for some crop other than strawberries. Local conditions largely govern the length of time a field is profitable.

In renewing a plantation, the tops should first be cut with a mowing machine. If injuries from diseases and insects are not serious, the foliage and mulch should generally be turned under or rototilled into the soil. This will increase the humus content of the soil and put it in better condition than if the straw and tops are burned. If the mulch is very heavy, it may be necessary to remove part of it before plowing. If the mulch is not decayed too much, it is sometimes raked up and stacked for use the following year, and only the strawberry foliage is plowed under. In all sections where renewing is done, the aim should be to obtain large, vigorous plants by October, when fruit-bud formation begins in much of the South.

Where insects and leaf-spot diseases are prevalent, growers often prefer to burn the foliage and mulch in the field. It is then easier to thin the plants than if the mulch and leaves are left. As soon as the foliage has dried, the mulch should be raked on top of the rows. When a good breeze is blowing in the direction of the rows, a fire should be started on the windward side. When burning is done in this way, the fire will pass quickly, and the roots and crowns of the plants are not likely to be injured. The mowing and burning should be done immediately after the crop is harvested.

The grower gives plants a better chance to develop if he reduces the number of plants in thick matted rows. The amount of thinning necessary depends on the variety and to some extent on the season and the soil. Usually the plants should be thinned 8 to 10 inches apart. They may be thinned by running a spiked-tooth harrow or cultivator across the rows once or twice and once down the row. The weaker plants are torn up by this process. A hoe may be used to further thin the plants if they are still too thick. Within 2 or 3 weeks, under favorable conditions, the plants will have sent out new foliage and the field will have the appearance of a young plantation.

In some areas the rows are moved by plowing up one side of each row one year and having the remaining plants set runners in the alleys. The other half of the old row is plowed up the following year when the plantation is renewed. In the third year the rows run where the alleys were.

Harvesting

Pickers and Picking

Strawberries must be handled with great care if they are to reach the market in the best condition. The field should be picked over at least every other day. At the height of the season it may be necessary to pick berries daily. No ripe berries should be left, because at the next picking they will be too soft to ship. One soft berry in the basket may spoil the entire contents, and one spoiled basket of berries may spoil the looks of the crate by the time it reaches the market. The growth habit of the foliage

18887, 18926, 18927

Figure 24.—*A*, Strawberry plants that were set in September, showing open habit of growth. These berries are much easier to pick than those that are concealed by foliage, as in *B*. (Photographed at Chadbourn, N. C., May 3.) ● *B*, Klondike plant, showing heavy foliage, which hides the berries. ● *C*, The same plant shown in *B*, but with some leaves removed.

and the differences in growth of different varieties make it more difficult to pick clean in some sections than in others. Dense foliage may hide the berries, as shown in figure 24, *B* and *C*. The more open habit of growth is shown in figure 24, *A*.

The stem should be pinched off in picking. About half an inch should be left attached to the berry. Each berry should be placed carefully (not thrown or dropped) in the basket. Baskets of berries should never be left in the sun, but should be taken to the packing shed or placed in the shade as soon as possible after the fruit is picked.

Pickers are paid by the quart. The amount paid varies with the area, with the grade of work done, and with the management plan. In one area pickers are paid by the gallon, and if they stay until the end of the season, they are given an

20291 (A)

Figure 25.—Six-basket carrier commonly used in picking berries.

extra cent or two for each gallon picked during the season. In another area growers pay the best pickers one-half cent a quart more than they pay untrained and poor pickers. The extra pay encourages careful work, and the berries are worth more when handled by the best pickers.

The number of pickers to the acre varies greatly. Where the yields are small, 2 can do the work. At the height of the season, 8 or 10 per acre are sometimes needed in the best fields. On a field yielding 100 crates (24-quart) to the acre, 4 pickers, working every day, should take care of the crop.

There should be very few berries that are not of the best market grade in a field that is tended carefully. Some fields have almost perfect berries, and no sorting is necessary after picking. The best crops are obtained by spacing the plants properly in the row and weeding the field thoroughly. There must be sufficient mulch and humus in the soil to maintain an adequate supply of moisture while the berries are growing and ripening.

Carriers

Carriers that hold six baskets are used in most areas in the South Atlantic and Gulf Coast States. The carrier shown in figure 25 is cheaply constructed and very convenient.

Suitable varieties

Only eight varieties of strawberries—the Klondike, Klonmore, Blakemore, Albritton, Massey, Florida Ninety, Ranger, and Missionary—are grown extensively in the South Atlantic and gulf coast regions.[3] Figure 26 shows where each variety is grown.

The Florida Ninety and Missionary grow better than the other varieties in the shortest days of the winter and with higher temperatures. The Klonmore is next best adapted, and the Klondike is next to the Klonmore. The Blakemore, Albritton, and Massey need more cold in order to start vigorous growth. Therefore Florida Ninety and Missionary are the best varieties in Florida, the Klonmore in the area just north within a hundred miles of the gulf coast, and the Blakemore north of the Klonmore belt.

The Florida Ninety and Missionary are almost the only varieties grown in Florida. The Klonmore is the leading variety within a hundred miles of the gulf coast from western Florida over to Texas, and the Ranger and Missionary in the southern part of Texas; the Blakemore is the leading variety northward.

The chief varieties in eastern North Carolina are Albritton and Massey. In 1957 near Norfolk, Va.,

[3] For a more complete discussion of strawberry varieties, see USDA Farmers' Bulletin 1043, Strawberry Varieties in the United States.

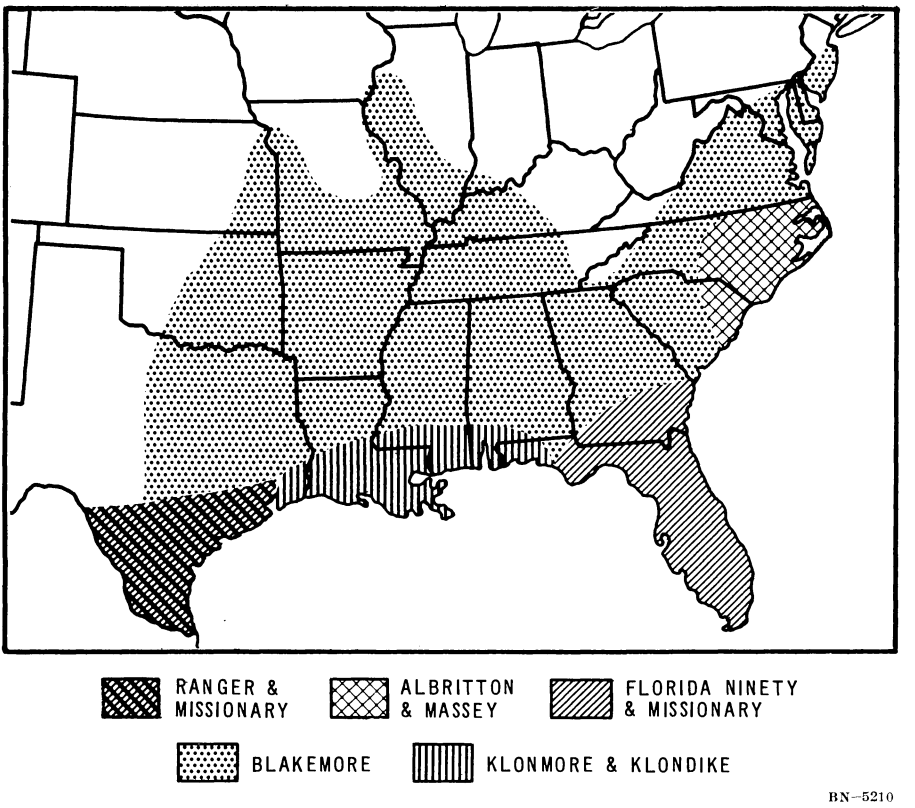

Figure 26.—Where southern strawberry varieties are grown.

the Blakemore was the chief variety grown, though the new Pocahontas and Dixieland varieties are being tested there as well as in all the area where the Blakemore is grown.

Diseases and insects

This bulletin contains no detailed discussion of strawberry diseases, except those caused by nematodes, or of insect enemies. The grower should familiarize himself, so far as possible, with those that are likely to occur in his locality, and thus be able to recognize and combat them as soon as they are discovered.

Information on diseases and pests may be found in many bulletins of the State agricultural experiment stations and State agricultural colleges, and in publications of the U. S. Department of Agriculture.[4]

Growers should keep in close touch with the experiment stations in their own States, and upon discovering unfamiliar insects or diseases should send specimens to the stations or to the U. S. Department of Agriculture for examination. Early recognition of an insect or a newly discovered disease in a community may make it possible to ap-

[4] Diseases are discussed in USDA Farmers' Bulletin 1891, Diseases of Strawberries; out of print but may be consulted in libraries in most large cities. See also USDA Leaflet 414, Reducing Virus and Nematode Damage to Strawberry Plants. Insects and diseases are briefly discussed in Home and Garden Bulletin 46, Insects and Diseases of Vegetables in the Home Garden.

ply control measures that will prevent a serious outbreak.

Strawberry products

More than half of the total commercial strawberry crop of the United States is frozen either for manufactured products or for desert use. Among the more important strawberry products are preserves, jams, essences for flavoring candies, flavoring extracts, sirup for soda fountains, and crushed fruit for flavoring ice cream and sauces. Klondike, Blakemore, Missionary, and Albritton varieties are superior to most strawberries for some of these purposes. The best varieties for preserving have a strong strawberry flavor. They are light, bright red, and acid, and have firm flesh that will not break to pieces in cooking. Among the best varieties for preserving are the Blakemore and the new Dixieland.

Varieties with a deep red color and high flavor are desired for the ice-cream trade. The Klondike is one of the best varieties for flavoring ice cream and for the frozen food industry. The Missionary and Blakemore are also good for these purposes.

Southern berries are rarely canned. Because of the wide use of cold storage lockers and home freezers, freezing strawberries and other fruits is replacing canning and to some extent even preserving for home use.

To prepare strawberries for freezing, mix 4 parts berries with 1 part sugar, by weight. Place the mixture in freezing storage as soon as possible.

Manufacturers of crushed and preserved fruits and sirups, used by the soda-fountain and ice-cream trade, prepare their products as they are needed during the year.

Before the berries are frozen they must be hulled, sorted, and washed. Various kinds of washing machines are used. Usually the machine has a water tank at one end and the berries are dumped into it for a brief soaking to loosen the dirt. The berries are removed from the tank by an endless belt that carries them under sprays of fresh water. The belt delivers the berries to inspection belts where the water drains away and the final sorting and grading are done.

The berries are then put in containers with the desired quantity of sugar. Usually the proportion is 1 pound of sugar to 4 pounds of fruit, though 1-to-3 and 1-to-5 packs are also made, since these are preferable for some purposes. Tin containers holding about 30 pounds of the mixture of berries and sugar are used. The sugar and berries are put in cans in alternate layers and mixed by machine or by hand. A jolting platform that jars the can as it is being filled with berries and sugar is commonly used. As soon as the cans are filled, they are shipped to a cold-storage warehouse, where they are stored for at least a week at −20° F. and then held at about 0°.

About 200 million pounds of strawberries are put up in this manner every year.

For dessert use, berries for freezing are packed in small cartons, which usually contain about 1 pound of berries, either whole or sliced, and ¼ pound sugar added.

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